Research Software Engineer Candidate Project

Brown University

December 7, 2018

Overview

This project has two primary components; the first is to construct a single-page web app, and the second is to read and interpret a specific Federal regulation pertaining to the Food and Drug Administration (FDA) guidelines on the design controls of medical devices.

You have 10 days to work on the assignment but we would only expect that you spend somewhere between 8 and 16 hours on it. We would not expect you to spend more time than that.

For the web app, we ask that you use Node.js for your app's backend, and whichever frontend web framework you prefer (e.g., React, Vue, Ember). The only caveat is that the project should use open-source tools.

1 Web App

The aim of the first part of this project is to construct a single-page web application that displays data from PubMed/MEDLINE. The specific functionality requirements are outlined more thoroughly below. This project helps us to assess your web app development skills, your experience with Node.js, and your technical problem-solving skills. Additionally, it is a fairly decent approximation of the sort of work you might be asked to complete in this role.

This project should have three main components:

1. A SQL database, loaded from PubMed/MEDLINE
2. A backend server (using Node.js), which connects to and queries the database
3. A frontend application with a table and visualization

1.1 The Data

You can obtain the data for this project from the National Library of Medicine's (NLM) PubMed/MEDLINE API. Many popular web and technical computing languages have modules for querying the PubMed/MEDLINE database programmatically via the Entrez Programming Utilities (EUtils).

1.1.1 Query

You will be making use of two of the EUtils tools—ESearch and EFetch. And again, these can be called from several popular technical computing language. For the query, you will need to return the metadata for publications appearing in PubMed between 2000 and 2014 with a Medical Subject Heading (MeSH) descriptor of *Epilepsy*. The exact search term for the query is `("epilepsy"[MeSH Major Topic]) AND ("2000/1/1"[ppdat] : "2014/12/31"[ppdat])`.

Note: EUtils only returns 10,000 articles at a time, so the program to load the database will need to handle iteratively fetching the data.

1.1.2 Storage

Use EUtils to return data in the form of XML. Next, parse the XML and extract the following information for each publication.

1. PubMed ID
2. Article title
3. Publication date
4. Authors

These data should be stored in a relational SQL database (e.g., MySQL, PostgreSQL, SQLite), which will serve data to your web app. The database schema design decisions are up to you, but should reflect the requirements of the web app.

1.2 The App

Using Node.js for the backend, and whichever frontend framework you prefer, you will develop a single-page web application with the following two components: a table, and a simple

visualization. Your web app should be communicating with the relational database you previously set up to store the results of your PubMed search for epilepsy. Apart from these requirements and the specifications below, the aesthetic and design decisions of the application are up to you.

1.2.1 Table

The requirements for the table appear below.

1. Display four columns: PubMed ID, article title, authors, and publication year
2. Limit results to 20 rows ordered by publication date, most recent first (pagination not required)
3. Have the capability to search on an author's last name in the database and display the results in the table

1.2.2 Visualization

You will also develop a visualization illustrating the number of publications over time that have epilepsy as a MeSH descriptor. This can simply be a bar graph or a time series plot, but feel free to experiment. The visualization should reflect the data in the database, not what is specifically displayed in the table. You can use whatever web visualization library (e.g., D3, Vega, Plotly) you prefer. But again, recall that it must be an open-source tool.

1.3 Deliverables

For the web app, please submit the following:

1. Program to load the DB
2. Simple entity relationship diagram for your DB
3. A video screen shot of the working Web App (please show off all of the features)
4. Zip file containing the source code for the web app
5. README (.txt or .pdf) describing:
    - Your thought process and the reasons for your design decisions of your app

- Brief instructions on how to load the database and run the app locally
- Note the approximate amount of time spent on the project - this is not used as a metric, but only for our own bookkeeping

2 FDA 21 CFR 820.30

The Code of Federal Regulation (CFR) entry FDA 21 CFR 820.30 describes regulations for the design of medical devices.

Describe how the FDA 21 CFR 820.30 relates to the development of software that might control a therapeutic device. Then describe the implementation of 21 CFR 820.30 in the design and writing of software that controlled therapeutic electrical stimulation of the nervous system based on readings from an accelerometer on your iPhone.

2.1 Deliverable

Please submit your write up for part 2 as part of the README for your web app.